RESEARCH DISCLOSURE · PUBLIC SUMMARY

CUSTOS LUMINA

PHASE 1

A Multi-Domain Cosmic Anomaly Identification, Classification and Protection Framework

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1. OVERVIEW

Custos Lumina is a research framework for the unified identification, classification, and archival of cosmic anomalies — objects, phenomena, and patterns in observational data that deviate from expected natural behavior. The framework addresses a gap in current space science infrastructure: no existing system integrates multi-domain observational evidence, formal classification, and cryptographic data provenance in a single interoperable record.

The name derives from the Latin custos (guardian) and lumina (light/luminous bodies), reflecting the framework's purpose: systematic, rigorous, and trustworthy stewardship of knowledge about the cosmos. The guiding philosophy is that genuine scientific inquiry — quaerens, meaning 'seeking' — requires not only observation, but also transparent, reproducible, and tamper-evident documentation of what is observed.

2. PROBLEM STATEMENT

Current space observation systems operate in isolation: asteroid warning networks track orbital dynamics; spacecraft telemetry systems monitor engineering health; astrobiological surveys analyze chemical composition. When an anomalous object or phenomenon spans multiple domains — as demonstrated by recent interstellar object detections — no unified classification protocol exists. This fragmentation produces inconsistent responses, delays in scientific communication, and vulnerability to data integrity compromise.

Additionally, space science data pipelines were designed before the era of quantum computing. Historical anomaly records — accumulated over decades — are potentially vulnerable to retroactive forgery by adversaries with sufficient computational resources. No operational space data standard currently mandates post-quantum cryptographic provenance for scientific records.

3. THREE OBSERVATIONAL DOMAINS

Custos Lumina organizes observational evidence into three formally independent domains, each producing a structured evidence vector:

- **Physical Domain (PAV — Physical Anomaly Vector):** Captures deviations in gravitational fields, electromagnetic signal patterns, energy distribution, trajectory geometry, and velocity regime. Applicable to near-Earth objects, interstellar visitors, unexplained orbital perturbations, and energetic transients.
- **Environmental-Structural Domain (ESV — Environmental Structure Vector):** Captures geometric regularity, material composition anomalies, atmospheric chemical signatures, and temporal pattern persistence. Applicable to planetary surfaces, exoplanetary atmospheric characterization, and structural feature analysis.
- **Bio-Informational Domain (BIV — Bio-Informational Vector):** Captures molecular chirality patterns, metabolic activity indicators, information-bearing structural organization, and epoch-scale persistence. Applicable to astrobiology, prebiotic chemistry detection, and biosignature characterization.

The three domains are evaluated independently before integration, ensuring that anomalies invisible in one domain but present in others are not suppressed by single-domain analytical frameworks.

4. ANOMALY CLASSIFICATION

Custos Lumina defines five formal anomaly classes with deterministic assignment criteria:

Class Code	Name	Assignment Criteria
NR	Natural Regular	All domains consistent with known natural models; baseline reference
NI	Natural Irregular	One or more domains show deviation explainable by natural processes
AC	Artificial Candidate	≥ 2 domains anomalous; human or technological origin plausible; CP ≥ 0.75
NHC	Non-Human Candidate	All 3 domains anomalous; human origin conclusively excluded; CP 0.50–0.74
UC	Unknown Class	Insufficient data for classification; reserved for partial observations

Each classification is accompanied by a Confidence Profile (CP) comprising four independently weighted sub-scores: evidence strength, cross-domain consistency, temporal stability, and observational redundancy. The CP produces a composite score in the range [0.0, 1.0] that quantifies classification confidence independently of the class assignment itself.

5. DATA INTEGRITY AND CRYPTOGRAPHIC PROVENANCE

A central feature of Custos Lumina is that every classification record carries cryptographic provenance — a mathematically verifiable proof of authenticity and integrity that persists across decades and is resistant to future computational advances, including quantum computing. This is achieved through:

- Deterministic canonical serialization — identical inputs always produce identical records, enabling independent verification.
- SHA-3-256 hashing — a standardized cryptographic hash function (NIST FIPS 202) produces a unique fingerprint of each record.
- Post-quantum digital signatures — records are signed using algorithms standardized by NIST in 2024 (FIPS 204/205) that remain secure against quantum computers.
- Immutable distributed ledger — records are replicated across independent nodes; no single party can alter a confirmed record.

These properties together mean that a Custos Lumina record produced today can be independently verified by any institution decades from now, using only publicly documented cryptographic standards.

6. HIGH-AVAILABILITY ARCHITECTURE

The framework specifies a distributed network architecture designed to operate continuously under adverse conditions — including hardware failures, network partitions, and adversarial interference. The architecture comprises:

- Multiple independent orbital processing nodes operating simultaneously with data replication and consensus mechanisms.
- A terrestrial air-gapped forensic archive node serving as an offline backup and governance authority.
- Defined operational modes for normal, degraded, and emergency conditions, each with specific response protocols.
- A Zero-Trust security model in which every data record is independently verified regardless of its origin.
- A quarantine mechanism that automatically isolates anomalous records for human review rather than rejecting or silently discarding them.

7. INSTITUTIONAL GOVERNANCE

Custos Lumina incorporates a formal governance model designed to prevent single-actor control over a globally critical scientific infrastructure. Key principles include:

- Multinational representation — no single nation or corporation holds controlling authority.
- Quorum-based decision making — critical operational decisions require agreement from a qualified majority of independent representatives.
- Transparency ledger — all governance decisions are recorded in an append-only, cryptographically signed log.
- Term limits — rotating leadership prevents entrenchment of any single interest.
- Human primacy — automated systems provide analysis and advisory functions; strategic decisions remain with human governance bodies.

8. INTEROPERABILITY WITH EXISTING STANDARDS

Custos Lumina is designed for integration with existing space science infrastructure rather than as a replacement. The framework declares compatibility with:

Standard / System	Compatibility
NASA Planetary Data System v4 (PDS4)	Native adapter — Custos Lumina records map to PDS4 archival format

CCSDS Space Packet Protocol	Transmission protocol for spacecraft-to-ground record delivery
ESA ECSS Engineering Standards	Compliance with space software and data systems standards
NIST FIPS 202, 204, 205	Cryptographic hash and signature algorithms (SHA-3, Dilithium, SPHINCS+)
W3C JSON-LD 1.1	Linked data serialization for semantic web interoperability

9. POTENTIAL APPLICATIONS

The framework is applicable across a broad range of scientific and institutional contexts:

- Planetary defense — unified classification of near-Earth objects with formal provenance for inter-agency communication.
- Astrobiology — standardized documentation of potential biosignature detections with reproducible classification criteria.
- Space situational awareness — anomalous orbital behavior classification with cryptographic integrity for long-term archives.
- Interstellar object characterization — formal classification framework for objects with anomalous physical or compositional properties.
- Scientific archive integrity — post-quantum provenance for historical and future space science records.
- Autonomous space systems — formal communication protocol for inter-system state exchange and anomaly reporting.

10. CURRENT STATUS AND INVITATION TO COLLABORATE

Custos Lumina v3.0 is currently at the conceptual specification and formal documentation stage. The framework has been fully specified at the architectural, protocol, and governance levels. The inventor welcomes scientific dialogue, peer review, and exploratory collaboration with research institutions, space agencies, and standards bodies.

Institutions or researchers interested in evaluating the framework, contributing to its scientific validation, or exploring formal collaboration agreements are invited to contact the inventor directly. All collaboration discussions will be conducted under appropriate confidentiality agreements prior to disclosure of implementation-level technical details.

Contact: Carlos Daniel Borrego Romero — Life is good°.

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This public summary discloses only the conceptual framework and scientific purpose of Custos Lumina. No implementation details, source code, proprietary algorithms, schema specifications, or technical parameters sufficient to practice the invention are disclosed herein. The system described is protected under a pending PCT International Patent Application. No license, express or implied, to practice any aspect of the described invention is granted by this publication. © 2026 Carlos Daniel Borrego Romero — Life is good°.